

**SUMMARY OF DISCUSSION
TWELFTH MEETING
OF THE
US-RUSSIA EARTH SCIENCES JOINT WORKING GROUP
29-30 OCTOBER 2002
MOSCOW, RUSSIA**

The Twelfth Meeting of the Earth Sciences Joint Working Group (ESJWG) was hosted by the Russian Academy of Sciences (RAS) in Moscow, Russia, October 29-30, 2002. The meeting was co-Chaired by Academician Nikolai P. Laverov, Vice President, Russian Academy of Sciences, RAS, and Dr. Philip DeCola, Atmospheric Chemistry Program Scientist, NASA Headquarters.

The Russian delegation included representatives from the RAS, the Department of Earth Science RAS, the Institute of Atmospheric Physics (IFA RAS), the P.P. Shirshov Institute of Oceanology (IO RAS), the Institute of Radioengineering and Electronics (IRE RAS), the Institute of Applied Astronomy (IAA RAS), Institute of Geography RAS, the Center for Environmental and Forest Productivity Problems RAS, the Lebedev Physical Institute (FI RAS), the Institute of Geology, Petrology, Mineralogy, and Geochemistry (IGEM RAS), the Institute of Numerical Analysis (IVM RAS), the Institute of Water Problems (IVP RAS), the Institute for Astronomy RAS, the Space Research Institute (IKI RAS), Institute of Applied Physics (IPF RAS), Cell Biophysics Institute (IBK RAS), the Russian Aviation and Space Agency (Rosaviakosmos), Central Research Institute for Machine Building (TsNIIMash), Center of Space Observations (TsKN), Khrunichev State Research and Production Space Center (Khrunichev GPKNTs), the Russian Federal Service for Hydrometeorology (ROSGIDROMET), Planeta Scientific Research Center (NSC Planeta), Central Aerological Observatory, the Main Geophysical Observatory (GGO), All-Russian Institute of Hydrometeorological Information-World Data Center (VNII GMI-MTsD), the Zemlya Federal Cadastral Center, (Land FCC), St. Petersburg State University, Moscow State University (MGU), the Nansen Center, the Center for Monitoring and Information Technologies, ScanEx Information Technology Center, Information Systems-Integrated Research and Production Facility (NPK IS), and DATA+ Ltd. A full list of Russian participants can be found in Attachment 1.

The US delegation included representatives from NASA Headquarters, NASA Goddard Space Flight Center (GSFC), NASA Jet Propulsion Laboratory (JPL), the National Oceanic and Atmospheric Administration (NOAA), United States Forest Service (USFS), the Woods Hole Research Center, the World Resources Institute (WRI), University of Maryland, Oregon State University, University of Virginia, University of Michigan, and UCAR. A full list of US participants can be found in Attachment 2.

The Subgroups met and reported to the Co-Chairmen their highest priority initiatives and/or issues for the coming year. The Co-Chairmen endorsed the Subgroup reports, which can be found at Attachments 3-7. The agenda is at Attachment 8.

The Co-Chairman noted their satisfaction with the excellent progress made by the Subgroups over the past year and are encouraged by the important areas of new potential cooperation that was discussed during this meeting of the ESJWG. Of particular note are the following areas of collaboration:

- the collaboration on the upcoming second SAGE III Ozone Loss and Validation Experiment (SOLVE-2) aircraft campaign which will be conducted this winter in the Arctic to validate the joint US-Russian Meteor-3M/SAGE III spacecraft which was launched in December 2001;
- the collaboration on the aircraft campaign which will be conducted in February 2003 which will assist in the calibration and validation of the EOS-Aqua satellite which was launched in May 2002 and will study sea ice and adjacent ocean globally, including the Sea of Okhotsk, and joint field studies for validation and refinement of the processing algorithms of data from satellite ocean color sensors using commercial cruises on Russian scientific ships;
- the development of the Northern Eurasia Earth Science Partnership Initiative (NEESPI) which will identify the critical science questions and establish a program of coordinated research on the state and dynamics of terrestrial ecosystems in northern Eurasia and their interactions with the Earth's climate system to enhance scientific knowledge and develop predictive capabilities to support informed decision-making and practical applications;
- within the framework of joint collaboration on solid earth research, the conclusion of the agreement between NASA and RAS for the loan, installation and upgrade of a Mark III Very Long Baseline Interferometry (VLBI) station to be installed at the Svetloe station by the end of 2002, and the development of natural laboratories for the mitigation of natural hazards;
- the mutual understanding of the importance of enhanced collaboration on projects involving geographic data, such as aerial surveys, GPS and high-resolution data sets and products, which are used to calibrate and validate remotely-sensed data;

Both sides expressed satisfaction with the progress made during the past year. The Co-Chairmen encouraged the Subgroups to continue working closely together on ongoing activities and to implement those areas of new cooperation which have been identified as high priorities.

It was agreed that the Thirteenth Meeting of the Earth Sciences Joint Working Group would be held in the TBD 2003 timeframe in the US.

Signed, this day, the 30th October 2002,

Acad. N. P. Laverov
Russian Academy of Sciences

Dr. Philip DeCola
National Aeronautics and
Space Administration

RUSSIAN REPRESENTATIVES TO THE TWELFTH ESJWG

1. **N.P. Laverov**, Academician — Vice-President of Russian Academy of Sciences (RAS) (co-Chair, Earth Sciences Joint Working Group, Head of the Delegation)
2. **G.M. Polishchuk** — Deputy Director General, Russian Aviation & Space Agency (Rosaviakosmos) (Deputy Head of the Delegation)
3. **A.S. Isaev**, Academician — Director, Center of Environmental & Forest Productivity Problems, Russian Academy of Sciences (RAS) (Deputy Head of the Delegation), co-Chair Land Biosphere Subgroup
4. **O.A. Bogatikov**, Academician — Academician Secretary, Department of Earth Science, Russian Academy of Sciences (RAS)
5. **M.E. Vinogradov**, Academician — Chief Laboratory Manager, Shirshov Institute of Oceanology, Russian Academy of Sciences (RAS), co-Chair Oceanology Subgroup
6. **G.S. Golitsyn**, Academician — Director, Institute of Atmospheric Physics, Russian Academy of Sciences (IFA RAS), co-Chair Atmospheric Chemistry Subgroup
7. **V.N. Dyadyuchenko** — Deputy Chairman, Federal Service of Russia on Hydrometeorology and Monitoring of Environment (Rosgidromet), co-Chair Operational Monitoring Subgroup
8. **L.A. Vedeshin** — Cell Biophysics Institute, Russian Academy of Sciences (IBK RAS), co-Executive Secretary
9. **S.K. Tatevyan** — Head of Department, Institute of Astronomy, Russian Academy of Sciences (RAS), co-Chair Solid Earth Subgroup
10. **V.I. Lukyashenko** — Deputy Director, Central Research Institute for Machine Building (TsNIIMash)
11. **N.A. Armand** — Principal Research Scientist, Institute of Radio Engineering & Electronics, Russian Academy of Sciences (IRE RAS)
12. **G.M. Chernyavskiy** — Director, Center of Space Observations (TsKN)
13. **V.G. Bondur** — Executive Manager, Center of Monitoring & Information Technologies
14. **A.M. Finkelshtein** — Institute of Applied Astronomy, Russian Academy of Sciences (IAA RAS)
15. **E.A. Lupyan** — Deputy Director, Space Research Institute, Russian Academy of Sciences (IKI RAS)
16. **Yu. G. Safonov** — Deputy Director, Institute of Geology, Petrology, Mineralogy and Geochemistry, Russian Academy of Sciences (IGEM RAS)
17. **A.A. Chernikov** — Director, Central Aerological Observatory (CAO)
18. **A.P. Khrenov** - Principal Investigator, Research Group, Institute of Geology, Petrology, Mineralogy, and Geochemistry, Russian Academy of Sciences (IGEM RAS)
19. **L.P. Bobylev** — Director, The Nansen Center
20. **V.E. Gershenson** — Director General, Scanex R & D Center

21. **A.M. Volkov** — Head of Operative Monitoring Research Center, Rosaviakosmos
22. **V.V. Kozoderov** — Principal Research Scientist, Institute of Numerical Analysis, Russian Academy of Science (IVM RAS)
23. **O.V. Kopelevich** — Chief Laboratory Manager, Shirshov Institute of Oceanology, Russian Academy of Sciences (IO RAS)
24. **Yu. L. Obyedkov** — Chief Laboratory Manager, Institute of Water Problems, Russian Academy of Sciences (IVP RAS)
25. **N.F. Elansky** - Chief of Laboratory, Institute of Atmospheric Physics, Russian Academy of Sciences (IFA RAS)
26. **N.V. Sazonov** — Deputy Director, $\text{\textcircled{Z}}$ emlya Federal Cadastre Center (Land FCC)
27. **N.M. Vandysheva** - Chief Laboratory Manager, $\text{\textcircled{Z}}$ emlya Federal Cadastre Center (Land FCC)
28. **A.G. Georgeadi** — Chief Laboratory Manager, Institute of Geography, Russian Academy of Science (IGRAN)
29. **V.V. Asmus** - Director, $\text{\textcircled{P}}$ laneta Scientific Research Center

GROUP OF EXPERTS

30. **Yu. M. Timofeev** — Department Chief, Scientific Research Institute of Physics (NIIF), St. Petersburg State University
31. **G.S. Kust** — Scanex R & D Center
32. **D.V. Dobrynin** — Scanex R & D Center
33. **A.E. Ametistova** - Institute of Oceanology, Russian Academy of Sciences (IO RAS)
34. **A.A. Vetrov** - Institute of Oceanology, Russian Academy of Sciences (IO RAS)
35. **A. Yu. Ivanov** - Institute of Oceanology, Russian Academy of Sciences (IO RAS)
36. **G.K. Karabyshev** - Institute of Oceanology, Russian Academy of Sciences (IO RAS)
37. **S.V. Pereslegin** - Institute of Oceanology, Russian Academy of Sciences (IO RAS)
38. **A.V. Sokov** — Institute of Oceanology, Russian Academy of Sciences (IO RAS)
39. **I.M. Levin** — Siberian Branch of the Institute of Oceanology, Russian Academy of Sciences (SB IO RAS)
40. **M.T. Smirnov** - Institute of Radio Engineering & Electronics, Russian Academy of Sciences (IRE RAS)
41. **D.M. Ermakov** - Institute of Radio Engineering & Electronics, Russian Academy of Sciences (IRE RAS)
42. **D.V. Maslov** - Moscow State University (MGU)
43. **L.S. Dolin** — Institute of Applied Physics, Russian Academy of Science (IPF RAS)
44. **A.S. Luchinin** - Institute of Applied Physics, Russian Academy of Science (IPF RAS)
45. **E.A. Sharkov** - Institute of Space Research, Russian Academy of Science (IKI RAS)
46. **A.V. Ipatov** — Institute of Applied Astronomy, Russian Academy of Science (IPA RAS)
47. **Yu. A. Borisov** - Central Aerological Observatory (CAO)
48. **V.M. Kotsov** — Main Geophysical Observatory (GGO)

49. **V.B. Zakharin** — Institute of Ore Geology, Petrology, Mineralogy, and Geochemistry, Russian Academy of Sciences (IGEM RAS)
50. **S.E. Stramous** — Institute of Ore Geology, Petrology, Mineralogy, and Geochemistry, Russian Academy of Sciences (IGEM RAS)
51. **V.E. Shakarin** — Khrunichev State Research & Production Space Center (Khrunichev GKPNTs)
52. **V.V. Zaitsev** — DATA+ Ltd.
53. **O.V. Postyliakov** - Institute of Atmospheric Physics, Russian Academy of Sciences (IFA RAS)
54. **V.V. Ivanov** — Lebedev Institute of Physics, Russian Academy of Sciences (FI RAS)
55. **D.V. Shifrin** - Central Aerological Observatory (CAO)
56. **V.P. Savorskiy** — Institute of Geoecology, Russian Academy of Sciences (IGE RAS)
57. **S.V. Prokopchina** — Information Systems - Integrated Research & Production Facility (NPK IS)
58. **V.N. Razuvayev** — All-Russian Institute of Hydrometeorological Information — World Data Center (VNII GMI — MTsD)
59. **A.G. Paveliev** — Institute of Geoecology, Russian Academy of Sciences (IGE RAS)
60. **O. Ya. Izosimov** - Institute of Radio Engineering & Electronics, Russian Academy of Sciences (IRE RAS)

US REPRESENTATIVES TO THE TWELFTH ESJWG

1. **DeCola, Phil** NASA Headquarters, co-Chair Atmospheric Chemistry Subgroup, co-Chair Earth Sciences Joint Working Group, Head of Delegation
2. **Gutman, Garik** NASA Headquarters, co-Chair Land Biosphere and Hydrology Subgroups
3. **Trees, Charles** NASA Headquarters, co-Chair Oceanology Subgroup
4. **LaBrecque, John** NASA Headquarters, co-Chair Solid Earth Subgroup
5. **Kogan, Felix** National Oceanic And Atmospheric Administration Headquarters, co-Chair Operational Monitoring Subgroup
6. **Kay, Leslie** NASA Headquarters, co-Executive Secretary
7. **Brown, Daniel** University of Michigan
8. **Comiso, Josefino** NASA Goddard Space Flight Center
9. **Conard, Susan** United States Forest Service
10. **Csiszar, Ivan** University of Maryland
11. **Deering, Donald** NASA Goddard Space Flight Center
12. **Groisman, Pavel** UCAR
13. **Turner, Kelly** National Oceanic And Atmospheric Administration, National Environmental Satellite, Data and Information Services
14. **Krankina, Olga** Oregon State University
15. **Laestadius, Lars** World Resources Institute
16. **Ma, Chopo** NASA Goddard Space Flight Center
17. **Masek, Jeffrey** NASA Goddard Space Flight Center
18. **Pieri, David** NASA Jet Propulsion Laboratory
19. **Romanov, Peter** National Oceanic And Atmospheric Administration, National Environmental Satellite, Data and Information Services
20. **Schlesinger, Peter** Woods Hole Research Center
21. **Shugart, Herman** University of Virginia
22. **Zaneveld, Jacques** Oregon State University

ATMOSPHERIC COMPOSITION SUBGROUP

The Atmospheric Composition Subgroup was co-Chaired by Academician George S. Golitsyn (IFA RAS) and Dr. Phil DeCola (NASA HQ).

The overarching goal of the Subgroup is to advance understanding of how atmospheric composition influences and responds to climate change in order to develop models for the prediction of future climate change. The increasing concentrations of atmospheric constituents that absorb infrared radiation such as carbon dioxide, methane, tropospheric ozone and nitrous oxide are the primary forcing agents of global climate change. The anthropogenic emission sources leading to the observed growth rates of methane and nitrous oxide are qualitatively understood but poorly quantified. Trends in tropospheric ozone are not well determined and are driven by a mix of emissions, including regional pollutants and methane. In addition to these gases, water vapor plays a strong role in amplifying the greenhouse warming. Observations and trends of this highly variable constituent are problematic. We must understand the variability of atmospheric composition at all levels of the atmosphere.

The Subgroup discussed a number of ongoing and new cooperative investigations that will lead to significant progress in global change research. The highest priority activities for this Subgroup for the following year are:

Enhanced Meteor-3M/SAGE III collaboration: There continues to be a need for work related to the joint US-Russia Meteor-3M/SAGE III mission. The mission was launched in December of 2001 and has been generating ozone, aerosol, water vapor, nitrogen dioxide and temperature profiles needed for international assessment of the health of the stratospheric ozone layer. Our cooperation in this area moves along the four principle avenues of support for ongoing operations, data validation, algorithm enhancement, and scientific data analysis. Soon after launch, it was apparent that the GPS/GLONASS capabilities of the spacecraft were not functional--a serious loss hampering our orbital knowledge and our ability to analyze the data. Fortunately, a successful laser ranging experiment that was another part of the Meteor-3M mission has been able to provide the orbital elements with a precision adequate for the goals of SAGE III. The Subgroup notes that the fulfillment of the Meteor-3M/SAGE III science objectives requires the continuation of the laser ranging as part of ongoing routine operations.

The conduct of the second SAGE III Ozone Loss and Validation Experiment (SOLVE-2): In the area of validation, the Subgroup notes with anticipation this coming winter's second SAGE III Ozone Loss and Validation Experiment (SOLVE-2) aircraft campaign, that will be based in Kiruna, Sweden. The US will be flying a fully instrumented DC-8 aircraft and high-altitude balloons for measuring stratospheric composition throughout the

Arctic region, including over Russian territory. At the same time the Russian Geophysical aircraft, equipped with a number of instruments operated by Russian, US, German, UK and Italian investigators, will fly above the NASA DC-8 for direct measurements within the stratosphere. There will also be a number of ground-based, and small balloon observations made by Russian scientists within Russian territory, as well as joint US-Russian analysis of the obtained correlative data. These measurements will be a critical source of correlative data for understanding the precision and accuracy of the Meteor3M/SAGE III data and for adding to our understanding of how the stratospheric ozone layer is responding to declines in the abundances of ozone destroying chemicals along with the increasing abundance of greenhouse gases.

Enhancement of retrieval algorithms: A number of researchers on both sides are working on the enhancement of SAGE III retrieval algorithms for the measurement of trace constituent profile abundances via solar occultation, lunar occultation and the newly developing methods of UV/Visible limb scattering. The joint work in the area of limb scattering is particularly important due to the selection of this method for the future operational monitoring of stratospheric ozone and the significant inherent challenges of this method. New data on the CO₂ content of the mesosphere can be valuable for developing improved infrared remote sensing retrieval algorithms as well as for modeling the radiative balance of the upper atmosphere.

Ground-based networks within the Russian territory: An important additional area of cooperation is the collaborative work on ground-based observations of the variability of tropospheric and stratospheric composition and on the processes that drive these variations. Our future achievements in this area depend on updating and improving the standardization of the ground-based networks within the Russian territory, which are of great value as an important component of international globally distributed measurement networks such as the Network for the Detection of Stratospheric Change (NDSC). Another invaluable component of our joint ground-based activities is the Train laboratory for providing high precision and accuracy in situ observations of atmospheric composition, that are particularly important for studying tropospheric chemistry and its implications for global air quality. These measurements span important scales of local, regional and continental and help to connect to our increasing capabilities for observations on the global scale as our new capabilities for measuring tropospheric composition from space come on line.

Atmospheric aerosols: A major new research thrust of this Subgroup is in the area of atmospheric aerosols. It has been demonstrated that certain atmospheric particles (aerosols) cause cooling of the climate system (for example, sulfate), while others result in warming (for example, black carbon or soot). When climate models incorporate this new knowledge, they simulate the observed trends much better. However, one of the largest uncertainties about the impact of aerosols on climate is the diverse warming and cooling influences of the very complex mixture of aerosol types and their spatial distributions.

Further, the poorly understood impact of aerosols on the formation of both water droplets and ice crystals in clouds also results in large uncertainties in the ability to predict climate changes. This will be a focus of many new observational and theoretical investigations in the coming years.

Signed, this day, the 30th October 2002,

Acad. G. S Golitsyn
Russian Academy of Sciences

Dr. Philip DeCola
National Aeronautics and
Space Administration

SOLID EARTH SUBGROUP

The Solid Earth Subgroup was co-Chaired by Dr. Suriya K. Tatevian (RAS) and Dr. John LaBrecque (NASA HQ).

The Subgroup summarized activities during the past year, proposed to continue ongoing joint projects and discussed new proposals for future joint program. The Subgroup is pleased to report significant progress in areas of space geodesy, geodynamics, volcanoes and natural hazards research and confirmed their strong interest in continuing the fruitful cooperation.

Space Geodesy

Geodetic Very Long Baseline Interferometry (VLBI): Taking into account that Space geodesy is an important application of space technology in the area of natural hazards research and disaster management an Agreement on cooperation in the expansion of the international geodetic VLBI network and archiving data in the Crustal Dynamics Data Information System (CDDIS) for availability to the international science community has been signed in October 2002. A technical site visit and fringe test having been successfully completed, a NASA-loaned Mark III system will be installed at the Svetloe observatory before the end of 2002. Mark III operations within the international geodetic VLBI network will be scheduled on a regular basis after initial operational trials and resolution of communications or data exchange issues. The RAS-NASA memorandum for upgrading the Svetloe Mark III to Mark IV/V was signed during the Subgroup meeting on October 28, 2002, and operation expected by early 2004. Following successful Mark III installation and operation of Svetloe, the Subgroup recommends that 1) a Mark III/IV system also be installed at Zelenchukskaya for participation with the international network., and 2) Svetloe and other VLBI stations be connected by optical fiber links and intervening high capacity networks be established to allow the use of e-VLBI. The Svetloe station will observe up to three days per week with the international network. The VLBI station at Zelenchukskaya has observed in the Russian domestic network. In the interim, the Russian 4-channel DAS will be used for regular domestic geodetic observations. It is recommended that the Badary VLBI station to be completed in 2003 be equipped for international geodetic observations and that consideration be given of the collocation at the Badary site of SLR, GPS and other space geodetic techniques important to the realization of the international terrestrial reference frame. It is recommended that Svetloe and other VLBI stations be connected by optical fiber links or other broadband data links to be established to enable the use of e-VLBI techniques.

Satellite Laser Ranging (SLR): The participants agreed to continue working in SLR. SLR activities are now organized globally as the International Laser Ranging Service (ILRS), under the International Association of Geodesy. Russia currently is operating with three

active SLR stations within the ILRS (Maidanak; Mendeleevo and Komsomolsk na Amure), but the data quality and quantity from these stations are not meeting the requirements of the geo-science community. The Subgroup strongly encourage the tracking by the ILRS of an advanced optically tracked geodetic satellite planned by the Russian Aerospace Agency.

However, an improvement of the SLR network coverage in the area of Russian territory is very important to strengthen the global coverage of the global SLR network, which provides geocentric coordinate reference frame for geodetic, regional geodynamic and oceanographic programs. This subgroup strongly encourages the development and deployment of advanced SLR stations over the Asian continent.

NASA and RAS wish to explore the possibility of optimally siting two SLR2000 stations within the Russian territory in support of satellite tracking for Earth science purposes (GLONASS, METEOR-3M, JASON 1, etc) with the siting of Russian SLR stations in the US or other western hemisphere sites to improve the performance of the ILRS network. Site location(s) would be decided jointly based on resources and scientific requirements. Such a program would be pursued within the context of wider programmatic cooperation in geodesy in the framework of the ESJWG.

The Subgroup also supports the successful experimental results with laser ranging of the Russian satellite Meteor-3M, equipped with the new type of spherical reflector based on Luneburg lens principle, which provides an instrumental accuracy better than 0.1 mm. A development of the autonomous target microsatellite for the precise tracking may be of interest for the geodetic and geophysical community.

GPS network: The Russian GPS network including the RDAAC/NEDA is among the world's most technically advanced. The Subgroup recommends 1) the densification of the current GPS network in East Asia and the Caucasus to understand crustal deformation due to tectonic and volcanic forces and 2) co-location of VLBI, GPS, and SLR geodetic instruments for the Svetloe, Zelenchukskaya, and Badary sites; 3) an expansion of the permanent IGS network over the Russian and CIS territory and coordination of the data collection and processing from permanent IGS/GPS sites over North Eurasia area.. The progress made in development of the Russian GPS is very substantial, but the subgroup also recommends a more open exchange and expansion of fixed and field campaign GPS data for the Russian territory as these data are critical to natural hazards and geodynamics studies.

Emphasizing the valuable results of laser ranging tracking of several GLONASS satellites for the orbital control and predictions of the onboard frequency standards drift, the Subgroup recommends to increase the number of GPS and GLONASS satellites, equipped with optical retroreflectors.

Natural Laboratories

NASA has displayed substantial new space data including SRTM topography, MODIS, and ASTER which will provide significant new data for study in these Natural Laboratories. High resolution mapping data is critical to future understanding of the natural hazards potential in these laboratories. The group again recommends the focusing of space borne optical and electromagnetic sensors upon the areas of these Natural Laboratories .

The regions of the Tien Shan and the Western U.S. were defined as Natural Laboratories for Earthquake and Volcano research. The Subgroup reported significant progress in the deployment of GPS networks in these areas for studies of recent crustal movements and determination of the strained deformed state of the lithosphere from both GPS and INSAR measurements. About 1000 days of data collected at nearly 800 separate GPS sites at the Tien Shan area during the 9 years of measurements have been analyzed jointly by Russian and US scientists. The total convergence across the Kyrgyzs part of the Tien Shan is approximately 13–1.3 mm/yr in the longitude band between 75° and 76°. Differential height velocities across the network are about 4–1.8 mm/yr .

The Subgroup encourages further development of the OIVT RAS program in Central Asia, which includes a development of new local GPS networks, the monitoring of seismic activity with the use of telemetered seismographs of the KNET network, the electromagnetic and the magneto-telluric sounding of the Tien Shan —Pamir area.

The Subgroup again recommends the focusing of space borne optical and electromagnetic sensors upon the areas of these natural laboratories to combine seismic, geodetic and optical sensing to develop a strong database for the observation of precursor signals.

IGEM/RAS presented a comprehensive set of geological, geophysical, and geothermal data of Mt. Elbrus volcano and of the surrounding volcanic zone. Collaboration with USGS and NASA scientists and infusion of new space-borne data are encouraged. Natural hazards potential includes seismic, volcanic hazards and their impact on the large glaciers of the region. The Tien Shan component of the southern Asia Natural Laboratory is both substantial and well directed. The Subgroup high recommends continued support for research and research networks in the Caucasus-Tien Shan Natural Laboratory.

Kamchatka Volcanoes Research and Mitigation of related natural disasters: A comprehensive ASTER data acquisition program for Kamchatka and the Kurile Islands has been carried out, resulting in over 400 frames of VNIR, SWIR, and TIR ASTER data for both regions. A similar compilation of available SAR data for the region is recommended. Joint geologic analyses of these data will be carried out as part of both the ESJWG volcanological collaboration of IGEM/RAS and JPL/NASA and other interested colleagues, and as ongoing ASTER Volcanology Sub-team activities. It is desired by both sides that these regions be considered as part of any potential airborne research program

involving instruments such as synthetic aperture radar, lidar, and optical imaging (visible to far infrared), and that SRTM digital topographic data of the region be obtained for joint data analysis as soon as possible.

Volcanological and other natural hazards investigations in the Elbrus/Kazbek Volcanic Zone (Caucasus Mountains) has been carried out by specialists from IGEM/RA . A comprehensive set of geological, geophysical, and geothermal data of Mt. Elbrus volcano and of the surrounding volcanic zone has been presented by A. Gurbanov. These data were acquired from intensive geological field surveys in collaboration with the United States Geological Survey, as well as from analyses of single frame US NOAA AVHRR visible and thermal imaging of the area. This area of the Caucasus mountain belt has experienced repeated and regular volcanic activity throughout the Quaternary (722 Kyr to 2,000 years BP (0 AD), resulting in caldera formation and resurgent caldron activity. It is desired to continue detailed cooperative volcanological and natural hazard investigations, including acquisition and analyses of higher spatial and spectral resolution data from NASA Terra Platform instrumentation, such as ASTER and MODIS, as well as developing multiple frame time-series data sets from the more synoptic NOAA AVHRR instrument. NASA SRTM data and radar interferometry data may also be useful in this context. Such data would be validated by joint IGEM/RAS-USGS-led joint geological fieldwork. Geodetic imaging (e.g., lidar) and geodetic networks may be of great value in the resolution of region and local uplift due to resurgent volcanic activity. Discussion to explore this possibility should take place in the coming year.

Asia Pacific Arc: In 2001, the ESJWG designated the Kurile-Kamchatka-Aleutian Arcs as a Natural Laboratory for volcanic research. The prevalence of silicic explosive volcanoes across the North Pacific Rim poses significant risks for air traffic using the major international air routes that traverse the region, and vigorous subduction processes generate great earthquakes and tsunamis along this plate boundary. The goal of the subgroup is to advance the development of the Asia Pacific Arc (APA) Natural Laboratory, and to develop an international collaboration directed towards the accurate assessment of associated risk and the prediction of major explosive volcanic eruptions and great earthquakes. To achieve this, the Solid Earth Subgroup will formulate a joint research program focused on volcanological and geodynamic aspects of the APA and convene an international working meeting in the coming year sponsored by NASA and RAS to address these issues through the coordination of resources of different agencies and development of new capabilities (e.g., improved seismic and geodetic monitoring, improved remote sensing techniques).

New Proposals

Geopotential Field Surface Change Satellites: NASA successfully launched the Gravity Recovery and Climate Experiment (GRACE) satellite in March 2002. The satellite will begin its scientific data mission. Gravity data appear to permit a 10 to 100 fold

improvement over the EGM96 field. NASA will make data available to the broader research community including its Russian colleagues.

GPS Remote Sensing: The Subgroup encourages efforts to better define the physical processes that might link ionospheric phenomena to the imminent rupture of earthquakes. A possibility of cooperation for the development of new methods for radio occultation and bistatic radar studies of the atmosphere, mesosphere, and terrestrial surface from space using high-precision signals of radionavigational GPS/GLONASS satellite system has been discussed. The future cooperation may include joint investigations using experimental data of GPS/MET, CHAMP, SAC-C and other satellite missions to develop new bistatic radio holographic technology to study the atmosphere, ionosphere and terrestrial surface; and/or joint installation of new satellite radio physical bistatic radar experiment at GPS/GLONASS frequencies onboard of one of the future Russian satellite. NASA will consider a possibility to support this experiment by installation of Black-Jack GPS receiver. IRE RAS will consider a possibility to support this experiment by installation of high gain antenna >20 db at GPS frequencies.

Signed, this day, the 30th October 2002,

Dr. S. K. Tatevian
Russian Academy of Sciences

Dr. John LaBrecque
National Aeronautics and
Space Administration

LAND BIOSPHERE AND HYDROLOGY SUBGROUPS

The Land Biosphere Subgroup was co-Chaired by Acad. Aleksander S. Isaev (RAS), Dr. Yuri L. Obyedkov (IVP RAS) and Dr. Garik Gutman (NASA HQ).

NEESPI: The highest priority initiative for the subgroup is implementing formalized cooperation in the Northern Eurasia Earth Science Partnership Initiative (NEESPI). Recognizing their mutual interest in establishing a program of collaborative, coordinated research in the region of northern Eurasia, NASA and the RAS agree to develop a science plan in the NEESPI effort. The NEESPI will identify the critical science questions and establish a program of coordinated research on the state and dynamics of terrestrial ecosystems in northern Eurasia and their interactions with the Earth's climate system to enhance scientific knowledge and develop predictive capabilities to support informed decision-making and practical applications.

The NEESPI will include the monitoring and modeling of climate and ecosystem dynamics and feedbacks, measuring environmental impacts using in situ observations, state-of-the-art remote sensing and geographic information technology and modeling simulations for forecasting future scenarios. Special emphasis will be placed on the validation and calibration of satellite data products, and collection and exchange of data products. The result of scientific cooperation would be creation of a large-scale scientific program endorsed and sponsored by international science community directed at studying natural- and human-induced ecosystem processes at multiple scales (local, regional, continental) in northern Eurasia and their effects on global change.

NASA and the RAS will endeavor to solicit and ensure participation in the NEESPI by other national, public and private organizations of their respective countries consistent with the level of interest and support of those organizations for the NEESPI program. Additionally, NASA and the RAS will seek to include within the framework of the NEESPI other interested countries and international organizations who agree to cooperate and support the NEESPI organizational structure and research objectives. An important aspect to collaboration will be to develop and broaden the community of users of satellite data products and promote application of Earth science research results towards improved continuous monitoring and management of ecosystems and natural resources.

Along with scientific issues, NEESPI will devote attention and resources to public awareness, educational programs at various levels, and training specialists in NEESPI research and applications areas. Opportunities will be sought to involve teachers and students from lower grade levels through universities in the .. and Northern Eurasia through the use of existing programs, such as the Global Learning and Observation to the Benefit of Environment (GLOBE) and developing new collaborations and exchanges.

The science direction will be established through the multidisciplinary NEESPI Science Steering Committee, consisting of representatives from the US, Russia and international science community. The management structure and coordination of the program will be realized through the NEESPI Organizing and Coordinating Committee, consisting of representatives of cooperating, funding organizations from participating countries.

NASA and the RAS will seek to secure funds to support the NEESPI program and recognize that each agency shall bear the costs of supporting its organization's participation in the NEESPI planning and implementation activities. Financial support of NEESPI project will be realized through usual NASA and RAS mechanisms as well as other participating agencies. NASA and RAS, when serving as hosts in their countries for the NEESPI project planning and implementation activities, will assist with securing entry visas and facilitating other logistics associated with the agreed upon project activities. It is understood that the ability of the agencies to carry out their respective responsibilities is subject to their funding procedures and the availability of appropriated funds.

Central to this activity is developing a Science Plan for the NEESPI, which will be facilitated through conducting several focused scientific and organizational workshops, starting with the first one in March 2003, and then realized with a formal document in the summer of 2004. NASA will fund several unsolicited proposals on the topics of land cover and land use in 2003 as core NEESPI projects to be followed by additional NEESPI funding possibilities through one or more non-NEESPI NASA Research Announcements (NRA) during 2003 for funding beginning in early 2004. Future multidisciplinary NRAs are expected to be dedicated to NEESPI activities for two phases: Phase I: 2005-2008. Phase II: 2008-2010.

The Subgroup also identified several other areas for increased cooperation:

Enhancing the Terrestrial Ecosystems Subgroup activities: The need to increase the involvement of climate modelers and developers of land surface parameterizations in the current activities under ESJWG was discussed. More modelers will be invited to the follow-on workshops and invited to participate in joint projects. Additionally, it was considered that a comprehensive assessment of the global carbon cycle, surface heat balance, hydrological cycle, dynamics of land cover, and dynamics of coastal zone processes in Northern Eurasia is critical for proper understanding of contemporary climate change. Consequently, the following objectives were suggested as foci for development: 1) establishing ground-based and remote sensing systems for monitoring the key characteristics of the biosphere and climate of Northern Eurasia; 2) validation of NASA satellite products using ground-based observations; 3) development of climate and biosphere models specific for this region; and 4) creation of integrated technologies for

global change assessments for Northern Eurasia that will feed back into global climatic and biospheric models.

Hydrological studies: One of the main scientific fields of NEESPI is the hydrological component of the environment. The Subgroup identified four potential areas of future cooperation. They include 1) the influence of climate change and variability as well as land-use changes on the hydrologic cycle, ecology, and water quality of large rivers and their tributaries; 2) seasonal and inter-annual variability of high latitude, large-scale hydrological processes especially in permafrost regions (the focus here is on the several large rivers that flow into the Arctic Ocean including the Ob, Yenisei and Lena); 3) catchment changes and their impact on the coastal zone of Russia, and 4) the use of remote sensing data in hydrological studies (snow cover, land cover parameters, land-use etc).

Formation of the consolidated Terrestrial Ecosystems Subgroup: The Land Biosphere and the Hydrology Subgroups recommend that they be merged into one Terrestrial Ecosystems Subgroup. The lack of a critical mass in the Hydrology group participation and the intimate relations of biosphere and hydrology processes at the land surface and their interaction with climate and human processes provided the basis for this recommendation.

Signed, this day, the 30th October 2002,

Acad. A. S. Isaev
Russian Academy of Sciences

Dr. Garik Gutman
National Aeronautics and
Space Administration

OCEAN BIOSPHERE SUBGROUP

The Ocean Biosphere Subgroup was co-Chaired by Acad. Mikhail E. Vinogradov (IO RAS) and Dr. Chuck Trees (NASA HQ).

The subgroup discussed the progress made during the past year and the potential for new as well as continued activities for future cooperation. Some of the progress made by the Subgroup included the participation on two calibration/validation cruises (RV Ron Brown and the Akademik Ioffe); the development of regional and basin specific atmospheric and in-water algorithms; and the study of the seasonal dynamics of phytoplankton development in seas near Russia and Atlantic Ocean. There was a consensus to continue efforts of the Subgroup under the framework of the Ocean Color Research Team, the Sensor Intercomparison and Merger for Biological and Interdisciplinary Oceanic Studies (SIMBIOS) Project and the International Ocean Color Coordinating Group (IOCCG).

The highest priority initiatives and issues for the Subgroup are (not in order of importance):

- To continue US-Russian Ocean Color Validation and Calibration cruises. These will combine both commercial cruises on Russian scientific ships (to the Arctic and the Atlantic meridional transects), as well as other international ship-of-opportunity cruises. Expansion of the Aeronet network for aerosol continuous measurements at a number of Russian sites (IO RAS, NASA).
- To develop and refine bio-optical and atmospheric algorithms and to review measurement protocols (IO RAS, NASA).
- To merge ocean color data from SeaWiFS, Terra MODIS and Aqua MODIS to assess spatial and temporal variability of bio-optical properties in seas near Russia and to study the mesoscale dynamics (e.g. eddies, filaments) in coastal areas (IO RAS, IRE, RAS, NASA).
- To continue studying the physical, chemical, and bio-optical processes that affect natural and anthropogenic carbon fluxes in coastal, oceanic, and polar regions due to elevated atmospheric CO₂ and climate changes, using remotely sensed data (IO RAS, Cometa, NASA).
- To develop new theories and methods for measuring in-situ scattering, upper ocean particle distribution, and sea bottom bathymetry and imaging. Specifically, the methods and instruments being investigated are LIDAR, remote laser spectroscopy, volume scattering function meter (backward direction) and a b-

meter (total scattering). This will require innovative approaches to these measurements (MSU, IPF RAS, IO RAS, St Petersburg Branch IO RAS, NASA).

- To apply aircraft and satellite microwave radiometer measurements to study the effects of gravity-capillary waves on ocean color and SST data, to map the spatial variability and thickness of sea ice in the Sea of Okhotsk; and to study the physical and bio-optical variability of oceanic areas, when combined with other remotely sensed SST and ocean color data (IRE RAS, POI of Far East Branch of RAS, IO RAS, NASA).
- To extend the participation of US and Russian specialists, in particular young scientists and students, in the 2nd International Conference on Current Problems in Optics of Natural Waters (CONW—2003, St. Petersburg, September 2003), and to provide educational training cruises for remote sensing and bio-optical studies (St. Petersburg Branch IO RAS, IO RAS, NASA).

Signed, this day, the 30th October 2002,

Acad. M. E. Vinogradov
Russian Academy of Sciences

Dr. Chuck Trees
National Aeronautics and
Space Administration

OPERATIONAL MONITORING SUBGROUP

The Operational Monitoring Subgroup was co-Chaired by Dr. Valery N. Dyadyuchenko (ROSGIDROMET) and Dr. Felix Kogan (NOAA).

Over the next year, the Subgroup hopes to organize discussions and collaboration on the following issues:

- Tropical cyclone analysis using SSMI data (diagnoses and forecasts of their evolution and movement;
- Regional operational monitoring of precipitation zones with MODIS, AVHRR, and AMSU data;
- Research on multi-year changes in ice cover in the polar regions based on current and archived Russian data (Series Okean, Meteor, Resurs) and US data (NOAA, DMSP);
- Drought monitoring from polar-orbiting satellites: Comparison of regional and global scales;
- Desertification (and land degradation) as a function of climate change and land use;
- Monitoring of snow cover over Northern Eurasia with operational meteorological satellites. Comparison of Russian and US operational products. Validation of snow cover retrievals using ground-based observations from Russian meteorological stations.

Signed, this day, the 30th October 2002,

Dr. V. N. Dyadyuchenko
Russian Academy of Sciences

Dr. Felix Kogan
National Oceanic and
Atmospheric Administration

9:00 am	Opening Ceremony -Remarks by Academician Laverov, Russian co-Chair -Remarks by Dr. DeCola, U.S. co-Chair
10:00 am	BRIEF reports from Subgroup co-Chairmen (10 min each) -Atmospheric Chemistry and Dynamics Subgroup/SOLVE-2 -Land Biosphere and Hydrology Subgroups -Oceanography Subgroup -Solid Earth Studies Subgroup (+ VLBI) -Operational Monitoring Subgroup
11:00 am	Subgroup meetings -Atmospheric Chemistry and Dynamics Subgroup: Acad. Golitsyn, room 627 -Land Biosphere and Hydrology Subgroups: Acad. Isaev, President's Hall -Oceanography Subgroup: Acad. Vinogradov, room 527 -Solid Earth Studies + VLBI Subgroup: Dr. Tatevian, room 625 -Operational Monitoring Subgroup: Dr. Dyadyuchenko, room 525
1:00 pm	Lunch
2:00 pm	Subgroup meetings continue
6:00 pm	Adjourn for day

9:00 am	Subgroup meetings continue
1:00 pm	Lunch
2:00 pm	Plenary session -Reports by subgroup co-chairmen (20 min each) -Report on work of the Data Processing and Storing of Space Data Center of IRE RAS: Dr. V. P. Savorsky
5:00 pm	Discussion on Protocol/Summary of Discussion

5:30 pm Signing of Protocol/Summary of Discussion
ESJWG-12 concludes

6:00 pm Reception

8:00 pm Adjourn